

# Biology

The student will demonstrate an understanding of scientific and engineering practices

by: **BIO.1**

**a asking questions and defining problems** **BIO.1.A**

- i. ask questions that arise from careful observation of phenomena and/or organisms, from examining models and theories, and/or to seek additional information **BIO.1.A.I**
  - ii. determine which questions can be investigated within the scope of the school laboratory or field to determine relationships between independent and dependent variables **BIO.1.A.II**
  - iii. generate hypotheses based on research and scientific principles **BIO.1.A.III**
  - iv. make hypotheses that specify what happens to a dependent variable when an independent variable is manipulated **BIO.1.A.IV**
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**b planning and carrying out investigations** **BIO.1.B**

- i. individually and collaboratively plan and conduct observational and experimental investigations **BIO.1.B.I**
  - ii. plan and conduct investigations or test design solutions in a safe and ethical manner including considerations of environmental, social, and personal effects **BIO.1.B.II**
  - iii. determine appropriate sample size and techniques **BIO.1.B.III**
  - iv. select and use appropriate tools and technology to collect, record, analyze, and evaluate data **BIO.1.B.IV**
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**c interpreting, analyzing, and evaluating data** **BIO.1.C**

- i. construct and interpret data tables showing independent and dependent variables, repeated trials, and means **BIO.1.C.I**
- ii. construct, analyze, and interpret graphical displays of data **BIO.1.C.II**
- iii. use data in building and revising models, supporting an explanation for phenomena, or testing solutions to problems **BIO.1.C.III**
- iv. analyze data using tools, technologies, and/or models to make valid and reliable scientific claims or determine an optimal design solution **BIO.1.C.IV**

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**d constructing and critiquing conclusions and explanations** BIO.1.D

- i. make quantitative and/or qualitative claims regarding the relationship between dependent and independent variables BIO.1.D.I
- ii. construct and revise explanations based on valid and reliable evidence obtained from a variety of sources including students' own investigations, models, theories, simulations, and peer review BIO.1.D.II
- iii. apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and design solutions BIO.1.D.III
- iv. compare and evaluate competing arguments or design solutions in light of currently accepted explanations and new scientific evidence BIO.1.D.IV
- v. construct arguments or counterarguments based on data and evidence BIO.1.D.V
- vi. differentiate between a scientific hypothesis and theory BIO.1.D.VI

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**e developing and using models** BIO.1.E

- i. evaluate the merits and limitations of models BIO.1.E.I
- ii. develop, revise, and/or use models based on evidence to illustrate or predict relationships BIO.1.E.II
- iii. develop and/or use models to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems BIO.1.E.III

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**f obtaining, evaluating, and communicating information** BIO.1.F

- i. compare, integrate, and evaluate sources of information presented in different media or formats to address a scientific question or solve a problem BIO.1.F.I
- ii. gather, read, and evaluate scientific and/or technical information from multiple authoritative sources, assessing the evidence and credibility of each source BIO.1.F.II
- iii. communicate scientific and/or technical information about phenomena in multiple formats BIO.1.F.III

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The student will investigate and understand that chemical and biochemical processes are essential for life. Key ideas include: BIO.2

**A water chemistry has an influence on life processes;** BIO.2.A

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**b macromolecules have roles in maintaining life processes;** BIO.2.B

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**C enzymes have a role in biochemical processes;** BIO.2.C

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**d protein synthesis is the process of forming proteins which influences inheritance and evolution; and** BIO.2.D

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**e the processes of photosynthesis and respiration include the capture, storage, transformation, and flow of energy.** BIO.2.E

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The student will investigate and

**a the cell theory is supported by evidence;** BIO.3.A

understand that cells have structure and function. Key ideas include: **BIO.3**

- b** structures in unicellular and multicellular organisms work interdependently to carry out life processes; **BIO.3.B**
- C** cell structures and processes are involved in cell growth and division; **BIO.3.C**
- d** the structure and function of the cell membrane support cell transport; and **BIO.3.D**
- e** specialization leads to the development of different types of cells. **BIO.3.E**

The student will investigate and understand that bacteria and viruses have an effect on living systems. Key ideas include: **BIO.4**

- a** viruses depend on a host for metabolic processes; **BIO.4.A**
- b** the modes of reproduction/replication can be compared; **BIO.4.B**
- c** the structures and functions can be compared; **BIO.4.C**
- d** bacteria and viruses have a role in other organisms and the environment; and **BIO.4.D**
- e** the germ theory of infectious disease is supported by evidence. **BIO.4.E**

The student will investigate and understand that there are common mechanisms for inheritance. Key ideas include: **BIO.**

- a** DNA has structure and is the foundation for protein synthesis; **BIO.5.A**
- b** the structural model of DNA has developed over time; **BIO.5.B**
- c** the variety of traits in an organism are the result of the expression of various combinations of alleles; **BIO.5.C**
- d** meiosis has a role in genetic variation between generations; and **BIO.5.D**
- e** synthetic biology has biological and ethical implications. **BIO.5.E**

The student will investigate and understand that modern classification systems can be used as organizational tools for scientists in the study of organisms. Key ideas include: **BIO.6**

- A** organisms have structural and biochemical similarities and differences; **BIO.6.A**
- b** fossil record interpretation can be used to classify organisms; **BIO.6.B**
- c** developmental stages in different organisms can be used to classify organisms; **BIO.6.C**
- Dad** Archaea, Bacteria, and Eukarya are domains based on characteristics of organisms; **BIO.6.D**
- e** the functions and processes of protists, fungi, plants, and animals allow for comparisons and differentiation within the Eukarya kingdoms; and **BIO.6.E**
- f** systems of classification are adaptable to new scientific discoveries. **BIO.6.F**

The student will investigate and

- A** evidence is found in fossil records and through DNA analysis; **BIO.7.A**

**understand that populations change through time. Key ideas include:** **BIO.7**

- b** genetic variation, reproductive strategies, and environmental pressures affect the survival of populations; **BIO.7.B**
- c** natural selection is a mechanism that leads to adaptations and may lead to the emergence of new species; and **BIO.7.C**
- d** biological evolution has scientific evidence and explanations. **BIO.7.D**

**The student will investigate and understand that there are dynamic equilibria within populations, communities, and ecosystems. Key ideas include:** **BIO.8**

- a** interactions within and among populations include carrying capacities, limiting factors, and growth curves; **BIO.8.A**
- b** nutrients cycle with energy flow through ecosystems; **BIO.8.B**
- c** ecosystems have succession patterns; and **BIO.8.C**
- d** natural events and human activities influence local and global ecosystems and may affect the flora and fauna of Virginia. **BIO.8.D**